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(54) **METHOD FOR MANUFACTURING OXIDE FILM HAVING HIGH DIELECTRIC CONSTANT, CAPACITOR HAVING DIELECTRIC FILM FORMED USING THE METHOD, AND METHOD FOR MANUFACTURING THE SAME**

(75) Inventors: Jung-hyun Lee, Gyeonggi-do (KR); Burn-seok Seo, Seoul (KR); Yo-sep Min, Gyeonggi-do (KR); Young-jin Cho, Gyeonggi-do (KR)

(73) Assignee: Samsung Electronics Co., Ltd., Gyeonggi-do (KR)

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(51) **Int. Cl.**

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(52) **U.S. Cl.** 257/310; 257/296

(58) **Field of Classification Search** 257/296, 257/310

See application file for complete search history.

(56) **References Cited**

**U.S. PATENT DOCUMENTS**

|                |         |              |         |
|----------------|---------|--------------|---------|
| 3,996,021 A *  | 12/1976 | Chang et al. | 428/564 |
| 6,020,024 A    | 2/2000  | Maiti et al. |         |
| 6,486,080 B2 * | 11/2002 | Chooi et al. | 438/785 |
| 6,844,604 B2 * | 1/2005  | Lee et al.   | 257/410 |

|                   |        |               |         |
|-------------------|--------|---------------|---------|
| 6,930,059 B2 *    | 8/2005 | Conley et al. | 438/785 |
| 6,936,881 B2 *    | 8/2005 | Yeo et al.    | 257/310 |
| 7,112,539 B2 *    | 9/2006 | Lee et al.    | 438/763 |
| 2002/0014647 A1 * | 2/2002 | Seidl et al.  | 257/301 |
| 2002/0106536 A1   | 8/2002 | Lee et al.    |         |

**FOREIGN PATENT DOCUMENTS**

|                      |        |
|----------------------|--------|
| KR 10-2001-0022836 A | 4/2001 |
| KR 10-2002-0002991 A | 1/2002 |
| KR 1020020032054     | 5/2002 |
| KR 1020030002298     | 1/2003 |

**OTHER PUBLICATIONS**

Korean Office Action dated Jan. 11, 2010, in corresponding Korean Application No. 10-2003-0015197, with English translation. Sneh, Oler et al., *Thin film atomic layer deposition equipment for semiconductor processing*, *Thin Solid Films* 402 (2002) 248-261. Office Action issued by Chinese Patent Office on Mar. 21, 2007 for Chinese Patent Application No. 2004100283929. English Translation of Office Action by Chinese Patent Office on Mar. 21, 2007 for Chinese Patent Application No. 2004100283929. English translation of Korean Office Action dated Nov. 8, 2011 in corresponding Korean Application No. 10-2003-0015197.

\* cited by examiner

*Primary Examiner* — Ori Nadav

(74) **Attorney, Agent, or Firm** — Harness, Dickey & Pierce, P.L.C.

(57) **ABSTRACT**

Provided are a method for manufacturing a high k-dielectric oxide film, a capacitor having a dielectric film formed using the method, and a method for manufacturing the capacitor. A high k-dielectric oxide film is manufactured by (a) loading a semiconductor substrate in an ALD apparatus, (b) depositing a reaction material having a predetermined composition rate of a first element and a second element on the semiconductor substrate, and (c) forming a first high k-dielectric oxide film having the two elements on the semiconductor substrate by oxidizing the reaction material such that the first element and the second element are simultaneously oxidized. In this method, the size of an apparatus is reduced, productivity is enhanced, and manufacturing costs are lowered. Further, the high k-dielectric oxide film exhibits high dielectric constant and low leakage current and trap density. Thus, a capacitor including the high k-dielectric oxide film as a dielectric film also exhibits low leakage current and trap density.

1 Claim, 10 Drawing Sheets

